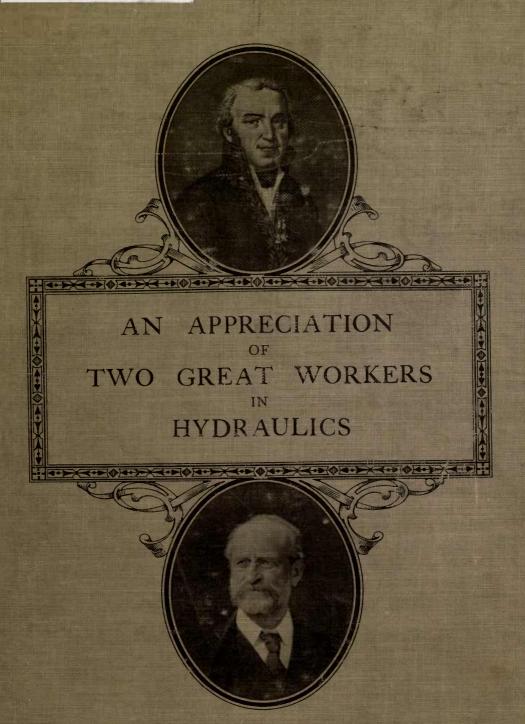
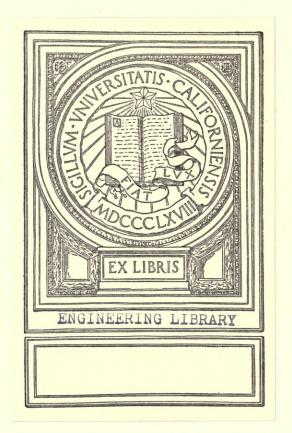
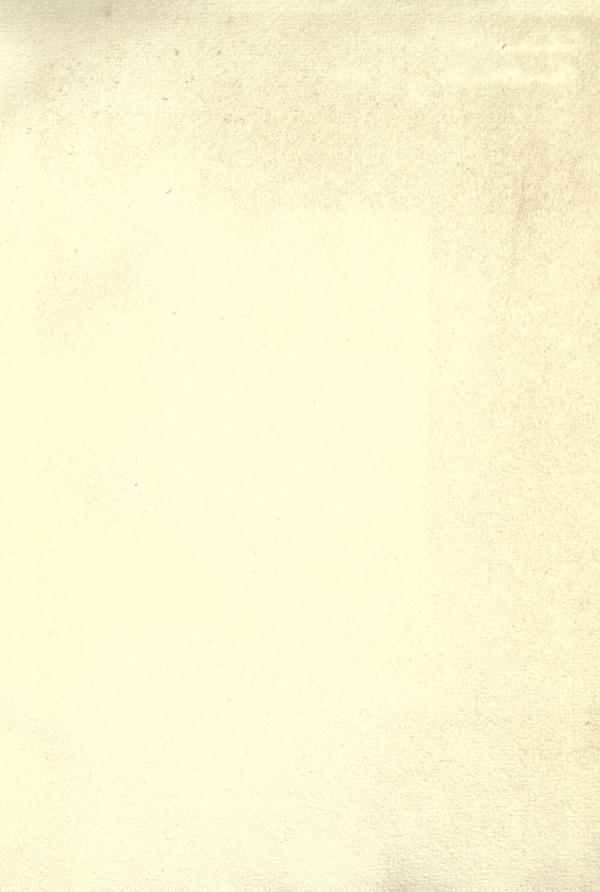


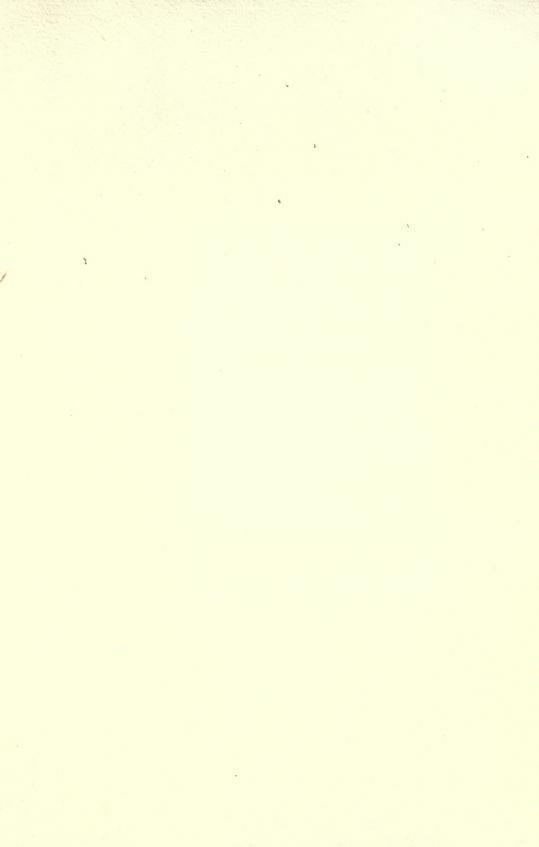
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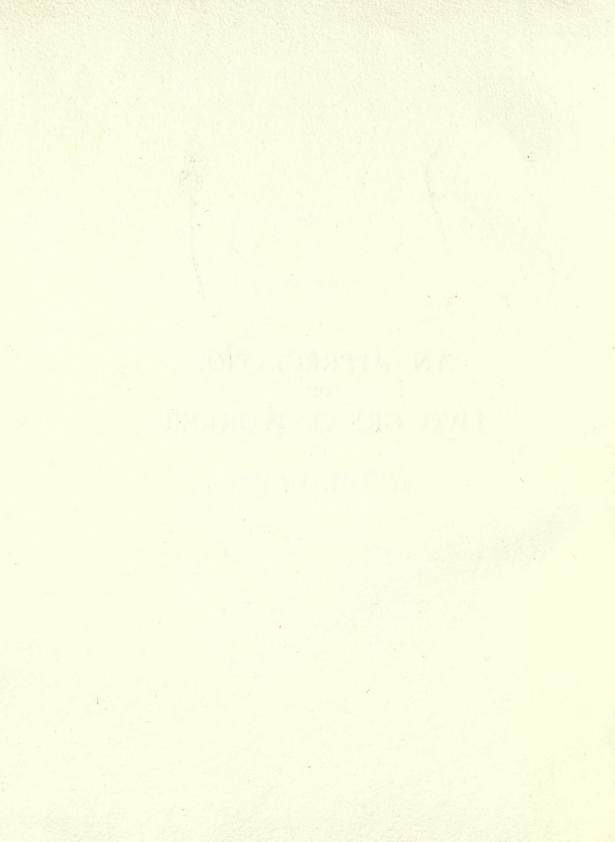
Edward W. Marris Boston, May 19, 1920.







AN APPRECIATION OF TWO GREAT WORKERS IN HYDRAULICS





AN APPRECIATION OF TWO GREAT WORKERS IN HYDRAULICS

GIOVANNI BATTISTA VENTURI BORN 1746 CLEMENS HERSCHEL

BORN 1842

BY

WALTER G. KENT

PRIVATELY PRINTED

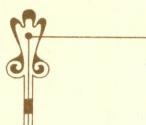
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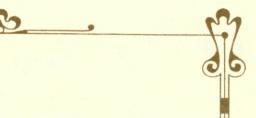
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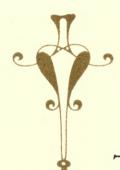
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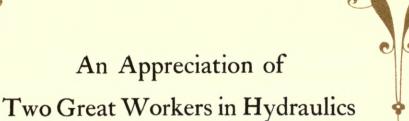
CLEMENS HERSCHEL, ENGINEER.

The Author gratefully acknowledges the kindly assistance of Professeur Ernesto Mancini, Ingénieur, Secretaire de la Présidence des Lincei, Rome, in his search for the portrait, biography and original works of Venturi.









GIOVANNI BATTISTA VENTURI

AND

CLEMENS HERSCHEL

FTEN indeed it happens that the germ of a great truth propagated in some fertile brain has lain fallow, and the harvest fallen years or centuries later to another's reaping. The germ may be complete, needing only sun, soil and air—interpretation, application and expansion—and possibly above all, Time. The great truth may have no immediate and apparent practical value. Too often the real worker or discoverer remains unknown.









In the especial case with which we are dealing, however, the pious worker has rendered due homage to his antecedent confrère.

Venturi and Herschel form an eminent and patent duality. The one, with creative, patient thought and experimentation, fully demonstrated the simple but beautiful natural Law he had discovered. The other seized the notion, saw its vast practical value, and not only proved its use by infinite and careful experiment, but adapted it for industry. True it is that Bernouilli and others furnished links in the chain, but the real credit is due to these two for the creation of the instrument known as the Venturi meter, which has enabled Water and Sewerage Engineers to grapple with and solve problems affecting the economy and efficiency of their work in a manner previously impossible.



Broadly stated, the Venturi Law, as the natural principle is termed that Venturi in 1797 formulated as the result of some of his investigations in hydraulics, is this: Fluids under pressure in passing through converging pipes gain speed and lose head, and vice versa for diverging pipes. The crude germ of this principle was known in ancient Rome and was employed in a rough way as a water-stealing device. Upon this natural law, Herschel, a century after Venturi, based and elaborated a simple but striking and ingenious instrument for the exact measurement of fluids in any bulk.

The size of the pipe or the volume of the water is immaterial. From a few inches to tens of feet, from trickles to rivers, all alike come within the scope of the Venturi meter.



THE FALLS OF NIAGARA.

Reproduced by kind permission of the High Commissioner for Canada.



Even Niagara itself, with its titanic forces and vast volumes of water, could be measured by this simple but efficient device. What mechanism could long withstand the terrific wear and tear and contact with such mighty power? The Venturi performs such a task easily because it has no moving part or mechanism in contact with the flowing water; its accuracy, dependent as it is upon an unvarying coefficient, remains unimpaired and exact, beyond that of unrated weirs or of mechanical meters with their ever present and often undetected "wear" factor.







CAV. GIAMBATISTA VENTURI.

Gentiluomo Reggiano, Prof. emerito di Pavia.

Membre del Cesareo Regio Istituto di Scienze &c.





GIOVANNI BATTISTA VENTURI

(Professeur de Physique Expérimentale à Modène; Membre de la Société Italienne, de l'Institut de Bologne, de la Société Agraire de Turin, etc., etc.)

Extracted from

"Notizie biografiche in continuazione della biblioteca Modense del Cavalier Abate Girolamo Tiraboschi," volume III.

(Reggio; tipografia Torregian e C., 1838) pagine 189-288.

GIOVANNI BATTISTA VENTURI was born in 1746 in Reggio (Italy), of a family in easy circumstances. He received there a good education, and while still young showed that he possessed a keen intellect and wonderful memory, being able to repeat word for word a sermon which he had heard







once. At twenty-three years of age he was ordained priest, and he became a professor in the seminary where he had passed his youth.

The value of Venturi was soon recognised, and he was called to the University of Modena, where he taught geometry and philosophy. Later his extensive knowledge obtained for him, through the Marquis of Rangone, Minister of the Duke of Modena, the posts of ducal mathematician, State engineer, and auditor. As Engineer he was engaged on many works, such as the building of bridges; rectification of water courses; draining of marsh land; and the establishment of State regulations for the construction of river dams.

Owing to his great reputation as an Engineer, Venturi became an authority on hydraulic questions, and was often applied to in cases of arbitration. He also took a keen interest in general scientific questions.





In 1786 he was given the post of Professor of Experimental Physics at the University of Modena, which gave him the opportunity of organising a laboratory which he furnished with the most up-to-date apparatus. These numerous occupations did not prevent the Abbé-Savant from studying literature and poetry; and at the death of the historian Tiraboschi he succeeded, with the aid of his great knowledge, in finishing the publication of historical memoirs of the town of Modena, a work which the death of Tiraboschi had left incomplete.

When the Duke of Modena undertook negotiations with the Supreme Executive Council of the French Republic, the Abbé Venturi became Secretary to the Legation and was sent to Paris. But soon recognising that the negotiations could not be brought to a successful issue, Venturi settled down





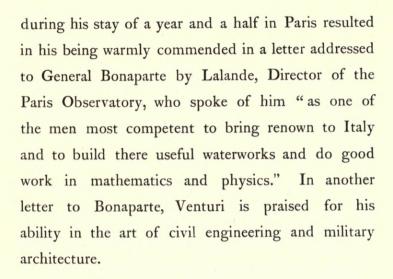
in Paris for some time in order to improve his knowledge of physics and chemistry. He there made the acquaintance of the most learned people of the age, such as Cuvier, Hauy, Biot, Lalande, Monge, Laplace, and many others.

During his stay in Paris, Venturi published several treatises; of these we may recall one on the movement of camphor on water, and another of greater importance, "Experimental Researches on the principle of the Lateral Communication of Movement in Fluids applied to the explanation of different hydraulic phenomena." It is this latter work which propounds and demonstrates that law of nature now known by Venturi's name.

He also published works on the researches of Leonardo da Vinci and of Galileo.

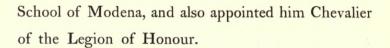
The deep respect in which Venturi was held





The Abbé Venturi made use of these letters in order to frustrate the intrigues of those in his country who tried to oust him from his position at the University, and also in order to seek the protection of General Bonaparte, who received him with great kindness. Bonaparte made him a member of the Corps Legislatif and a professor at the Military





Subsequent to this, however, adverse political influences were the cause of Venturi's being subjected to many vicissitudes, even to the extent of imprisonment. But after the conquest of Italy the First Consul gave him a professorship at the University of Pavia, and he was entrusted also with several diplomatic missions. During this period, in addition to his other numerous duties, Venturi found time to engage in mine work and hydraulic construction. Later he was made Diplomatic Agent of the Helvetic Confederation, which compelled him to study questions quite different to those to which he had devoted nearly all his previous career.

He spent some twelve years in Switzerland, during which time he accomplished his difficult





task in a manner that commanded the admiration and respect of all.

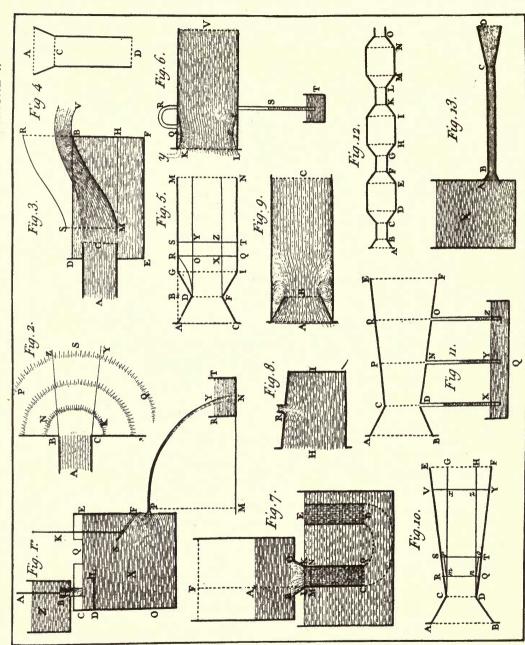
He eventually retired in 1813, owing to failing health, and was granted by the Emperor a pension on the maximum scale. On his return to Reggio he set about the publication of a number of scientific and literary works.

Venturi died in 1822, at the age of seventy-six.

As will readily be gathered from the foregoing, he was a man of remarkable talent and of extraordinary activity, which led him to study numerous questions and undertake many things. Savant, man of letters, and diplomatist, he always showed himself endowed with an observing and penetrating intellect, and with great ability in dealing with technical problems.

In reflecting on the widely varied character of the many offices and functions Venturi was called upon to fill and perform, one cannot fail to be





REPRODUCTION OF DRAWINGS MADE BY PROF. GIOVANNI BATTISTA VENTURI,



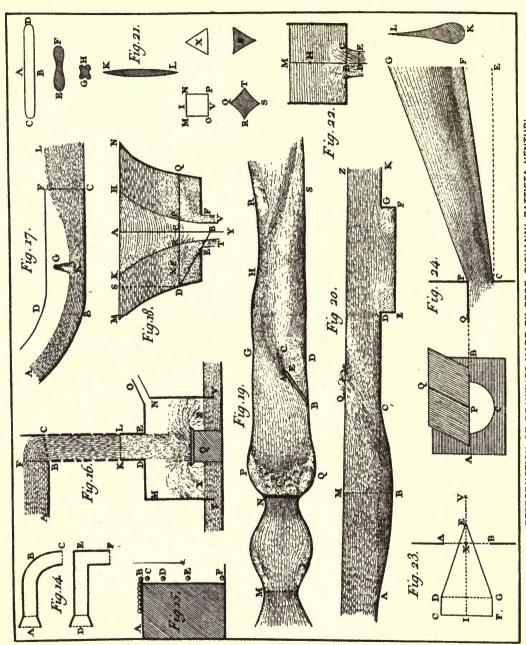
impressed by the great gifts and versatility of the man.

Eminently gifted, witty, frank, loyal, and a patriot as he was, it was left for Herschel to revive his reputation and add fresh lustre to his name.

The author has had the advantage of perusing what is probably one of only two or three copies extant of the work published by Venturi in the year 1797, entitled: "Recherches Expérimentales sur le Principe de la Communication Latérale du Mouvement dans les Fluides appliqué à l'Explication de Différens Phénomènes Hydrauliques," in which he describes the experiments undertaken to prove step by step his several propositions and theories with regard to the flow of water. It is beyond the compass of this short work to give extracts from this most interesting volume, but the drawings given in illustration of Venturi's letterpress are reproduced on the opposite and following pages







REPRODUCTION OF DRAWINGS MADE BY PROF, GIOVANNI BATTISTA VENTURI.

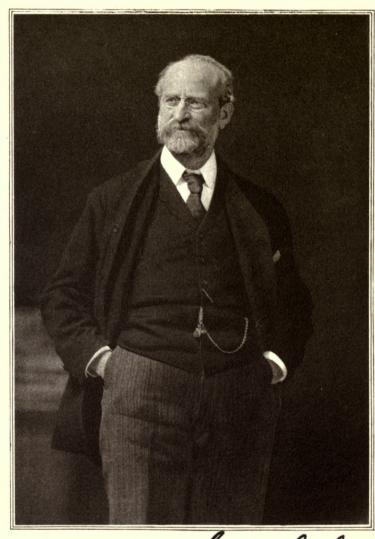


and will speak for themselves to all engineers who have made any study of this branch of hydraulics.









Clemens Herschel, 1906.





CLEMENS HERSCHEL.

(Past President of the Boston Society of Civil Engineers, Member American Society of Civil Engineers, Member Institution of Civil Engineers of London.)

CLEMENS HERSCHEL was born in 1842, graduated at Harvard University in 1860, and after a period of further study in France and Germany, returned to the United States and began to practise as a Civil Engineer.

His energies were at first turned to the design and construction of wrought iron bridges—of which several examples still attest the excellence of his work by the manner in which they carry the greatly increased loads produced by modern traction.

But the example and influence of that master of practical hydraulics, James Bicheno Francis





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(1815-1892), for more than forty years the "Agent and Engineer of the Proprietors of the Locks and Canals on Merrimac River," at Lowell, Massachusetts, author of "Lowell Hydraulic Experiments" and other writings, in whose activities it had been Herschel's privilege many times to take part, drew him away from other branches of civil engineering and led him to devote his principal efforts to the cause of hydraulic engineering.

This became a still more notable feature of his practice in 1879, on his accepting the position of "Hydraulic Engineer of the Holyoke Water Power Company" of Holyoke, Massachusetts, where he remained ten years.

The construction of the "Holyoke Testing Flume" was undertaken by him in 1881. This Flume was constructed in connection with a public hydraulic laboratory for the purpose of testing

PAGE 22



turbines and the making of other hydraulic experiments on a large scale.

He also introduced a system of metering and recording, twice each twenty-four hours, the amounts of water consumed by some 85 Turbines at work in the Holyoke Paper Mills and other manufactories, thereby increasing the income and value of the stock of the Company itself to a somewhat notable extent.

As a result of his system it was rendered possible to continue the lawful operations of the tenants of the Company and of the Company itself, who otherwise would have been in great embarrassment from the lawless procedure that always takes place in such cases where an uncontrolled communistic draft of water is permitted.

He also invented and carried out the experimental test of the Venturi Meter as described in Trans. Am. Soc. Civil Engrs., November, 1888.







The foregoing, together with much other work, mark his activities during the years at Holyoke.

Called to New York to undertake the construction of the works of the East Jersey Water Company, a corporation setting out to deliver a supply of water for domestic purposes in wholesale quantities to a group of New Jersey cities and towns, and which at one time did thus deliver over 80 million gallons of water daily, he was Superintendent and Chief Engineer of the Company until 1900.

He also took an active part as Consulting Engineer of the Niagara Falls Power Company, in the construction of the water-power plant of that company, and of the Canadian Niagara Falls Power Company; the pioneer electric-power plants of any magnitude in America, and perhaps in the world.

Herschel has contributed freely and in an entertaining and breezy fashion to the engineering



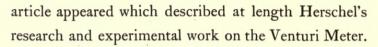


literature of the day, giving to the Profession the results and benefits of a wide experience in a way both to arrest attention and impart information.

He is the author also of several books, the most notable being entitled "The Two Books on the Water Supply of the City of Rome, of Sextus Julius Frontinus, A.D. 97. Dana Estes & Co., Boston, 1899." This quarto book contains the only photographic reproduction of the sole original manuscript of Frontinus' de Aquis, and the first translation into English ever made; also original explanatory chapters, a life of Frontinus, and other matter; and it is profusely illustrated. Herschel was moved to write it, after gathering material (for it) during some twenty years, to allow his fellow engineers, as he tells us, to share with him the pleasure of noting the accomplishments of the Romans in water-supply construction.

In Cassier's Magazine for March, 1899, an





The circumstances that led to the invention of the Venturi are given by Mr. Herschel in the following words:—

"While Hydraulic Engineer at Holyoke—I went there in 1879—I often had occasion to regret that I could not, in the pursuit of the duties of my office, meter the flow of large pipes, of 20" or greater diameter. I finally resolved in 1887 that I would experiment on the subject.

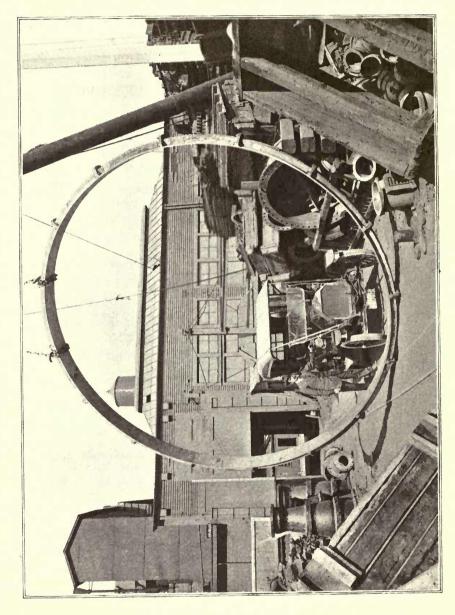
"My first conception of such a pipe-meter was to place an orifice in line of the pipe, and to measure the head on it by noting the difference between the heads measured, both upstream and downstream from the orifice.

"Then to avoid an undue loss of head in the apparatus, I conceived the idea of having a gentle upstream adjutage, and a 'Venturi' expanding tube or nozzle, downstream from the orifice. The experiments of 1887 were made under the influence of these ideas, the expanding adjutage being shaped in accordance with the results laid down in the book 'Lowell Hydraulic Experiments' of my former master, James B.

Francis, of Lowell, Massachusetts.

"But so soon as it became necessary to compute and co-ordinate their results, the present accepted theory for explaining the action, and formulæ for computing the discharges of the meter, were of necessity at once studied out, and the meter was by me named the 'Venturi' Meter, out of respect for Venturi's experiments of 1797."

The invention of the recording and registering devices by F. N. Connet, of Builders' Iron Foundry, Providence, Rhode Island, U.S.A., and by George Kent, London, to go with the meter, has contributed to the completeness and adaptability of the instrument. Some 5,000 Venturi Meters are now in use the world over. To Herschel was awarded the Elliott-Cresson Gold Medal of the Franklin Institute of Pennsylvania



CAST BRONZE INLET FRESSURE CHAMBER OF 17' O" DIA.. VENTURI METER FOR CATSKILL AQUEDUCT, NEW YORK WATER SUPPLY.



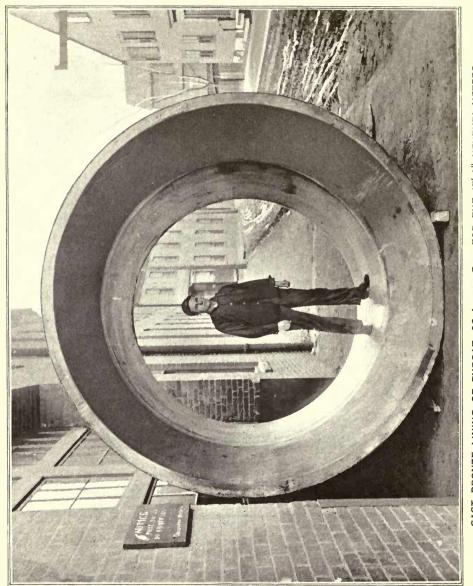
for his Venturi Meter in 1889, and the Scott Legacy medals were at the same time awarded to Connet and Jackson for their registering devices.

Until the year 1912, the largest meters in the world were the two Venturis installed at the pumping station at Divi, in the Madras Presidency. These giant instruments are each ten feet in diameter and seventy-three feet in length. They are each capable of passing three hundred and thirty-six million gallons per day.

These have, however, been ousted from their pride of place by the yet more monumental examples of the joint labours of Venturi and Herschel in the three monster meters which have just been put into the Catskill Aqueduct of the New York Water Works. These are each seventeen feet six inches in diameter and one hundred and forty-eight feet six inches long.

But the limit, in design at least, is even thus not attained. A Venturi tube no less than thirty-five feet

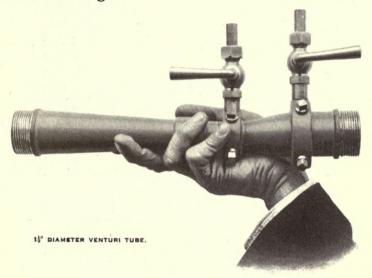




CAST BRONZE LINING OF THROAT, 93 INCHES DIA., FOR THE 17' O" VENTURI METERS. CATSKILL AQUEDUCT, NEW YORK WATER SUPPLY.



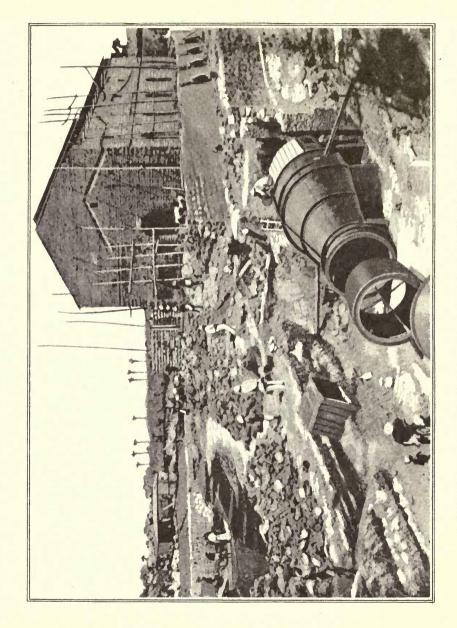
in diameter and three hundred and twenty feet long has been asked for. These are all very big brothers of the large family scattered over the world, the smallest of which is one-half of an inch in diameter and five inches in length.



A new field of interesting scope has been found for the instrument in the measurement of compressed air, steam, and gas.



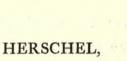




INSTALLATION OF A MAMMOTH "VENTURI" METER FOR MEASURING 14,000,000 GALLONS PER HOUR. INSERTING THE METER TUBE.







1887.

VENTURI,

1797.

In the brief review contained in the foregoing pages of the characteristics and work of two great contributors to the theory and practice of hydraulics, the salient features are probably the disinterestedness and breadth of view displayed by both.

This is exemplified in Venturi by his perseverance and sustained effort to discover the precise operation and underlying principles of certain hydraulic phenomena, which, as he divined with great prescience and sagacity, would be of no small practical value to those who were to follow him in the pursuit of his beloved science.





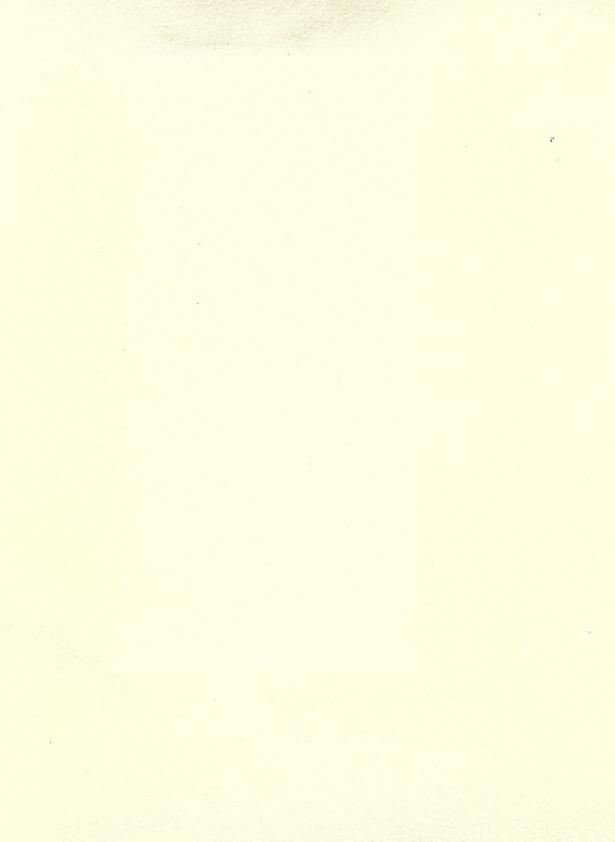


In Herschel these qualities are revealed by the rare and delightful self-effacement with which he coupled his own invention with the name of a long-forgotten engineer, who, but for this generous act, would have remained perpetually buried in oblivion. Thus, the credit rightly belonging to one who opens the road to greater efficiency in the practical work of his profession, was renounced by Herschel in favour of "Venturi," who, a century before, had but pointed the way.

The purpose of this appreciation will be served if those who hear the name of Venturi will thereby be reminded of that of Herschel, and give to both men the honour that is their due.







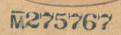
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